2016 Design Training Expo

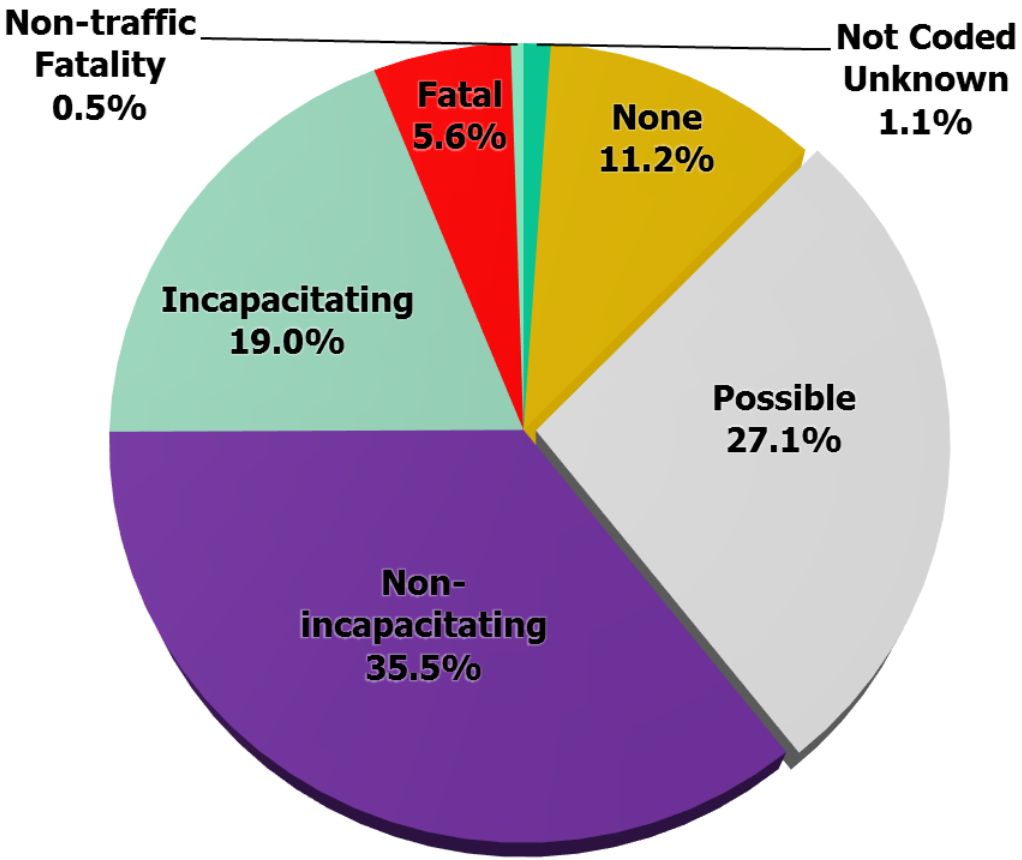
Intersection Lighting

Chester A. Henson, P.E.

Total Number of Pedestrian Fatalities

2009	482
2010	499
2011	497
2012	473
2013	498

Pedestrian Injury Severity



Distribution of Pedestrian Crashes

2013 Pedestrian Crashes			
Total	Crashes	Injuries	Fatalities
	8,410	7,467	498
Light		4,777	110
% of Total		64%	22%
Dusk		186	10
Dark - Lighted		1,583	222
Dark - Not Lighted		784	144
Dark - Unknown		21	3
Dawn		116	9
Total		2,690	388
% of Total		36%	78%

Nighttime Pedestrian Crashes at Signalized Intersections

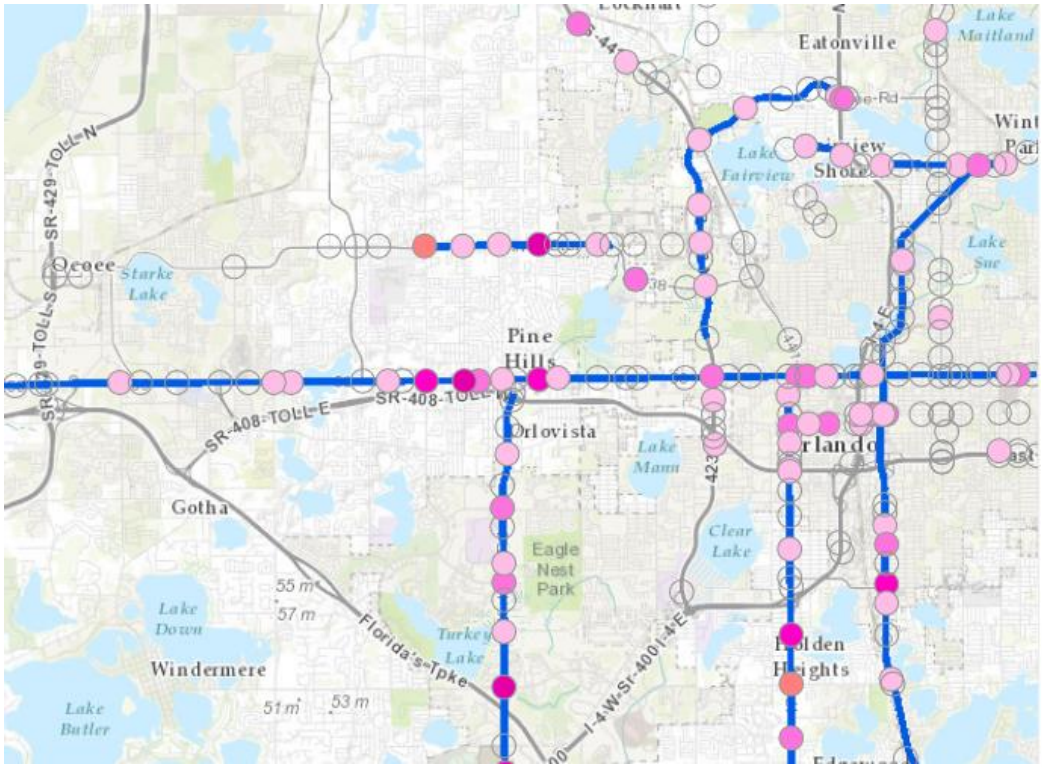
No. of Pedestrian Crashes	No. of Signalized Intersections
1	1456
2	418
3	158
4	62
5	29
6	10
7	0
8	3
9	3
	Total = 2,139

Top Twenty Intersections w/ Highest Nighttime Pedestrian Crashes

District	Town	SR No.	Intersection		Nighttime Pedestrian Crashes			Total Crashes
			On	At	Crashes	Injuries	Fatalities	
7	Tampa	SR 685	Florida Ave.	Waters Ave.	11	12	0	14
5	Orlando	SR 438	Hiawassee Rd.	SR 438	7	6	1	12
6	Hialeah	SR 9	27th Ave. NW	95th St. NW	7	3	2	7
6	Miami	US 1	Dixie Highway	SR 9	7	5	1	11
4	Ft. Lauderdale	SR 870	Commercial Blvd.	Powerline Rd.	7	5	2	9
4	Wilton Manors	SR 816	Oakland Park Blvd.	Powerline Rd.	7	8	0	11
4	Davie	US 441	SR 7	Griffin Rd.	6	6	0	10
6	Miami Gardens	SR 817	SR 817/NW 27th Ave	SR 860/Miami Gardens Dr.	6	5	0	17
6	Miami Shores	US 441	7th Ave. NW	95th St. NW	6	7	0	15
7	Tampa	SR 582	Fowler Ave.	15th St.	6	6	0	9
6	Miami	US 441	7th Ave. NW	79th St. NW	6	4	0	11
4	Lauderdale Lakes	US 441	SR 7	Oakland Park Blvd.	6	6	0	14
7	Clearwater	SR 60	SR 60	Belcher Rd.	6	7	0	9
4	Tamarac	SR 870	SR 870	SR 7	6	3	1	9
4	Ft. Lauderdale	SR 842	Broward Blvd.	Andrews Ave.	6	7	0	12
6	N. Miami Beach	SR 826	163rd St. NE	Biscayne Blvd.	6	4	2	11
6	Miami	SR 915	6th Ave. NE	135th St. NE	5	4	0	7
7	St. Petersburg	SR 699	Gulf Blvd.	Gulf Winds Dr.	5	2	2	5
4	Coral Springs	SR 817	University Dr.	28th St. NW	5	7	0	6
6	Coconut Grove	US 1	Dixie Highway	200th St. SW	5	5	0	8
					126	112	11	207

Safety Analysis of Nighttime Intersection Crashes

- GIS Application



Safety Analysis of Nighttime Intersection Crashes

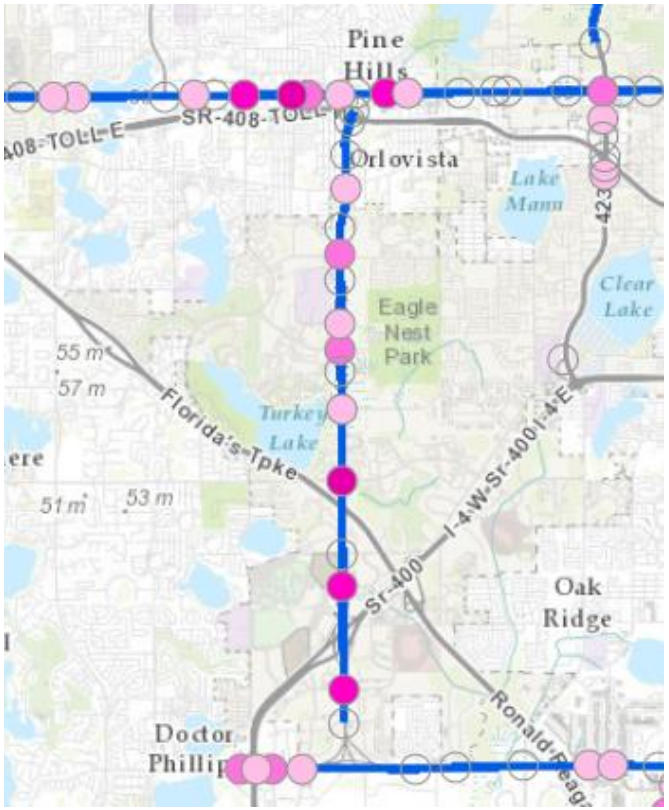
- GIS Application

Nighttime Crash Count by Signalized Intersection - 2009 to 2013

- 0 crashes
- 1 crash
- 2 crashes
- 3 crashes
- 4 crashes
- 5 crashes
- 6 crashes
- 8 crashes
- 9 crashes

Safety Analysis of Nighttime Intersection Crashes

- GIS Application



Nighttime Crash Count by Signalized Intersection - 2009 to 2013

- 0 crashes
- 1 crash
- 2 crashes
- 3 crashes
- 4 crashes
- 5 crashes
- 6 crashes
- 8 crashes
- 9 crashes

Safety Analysis of Nighttime Intersection Crashes

- Identified Corridors and Limits

	A	B	C	D	E	F	G
1	District -Rdwy ID	Begin MP	End MP	No. of Signals	No. of Crashes	No. of Injuries	No. of Fatalities
2	District 5			982	557	529	86
3	75251000	0.597	0.597	1	2	1	1
4	73220002	0.067	0.367	5	9	9	0
5	75250000	4.812	7.273	8	13	12	2
6	70160000	4.773	5.01	2	3	2	1
7	75010000	0.97	14.201	36	48	60	7
8	75003000	0.652	10.606	26	34	35	3
9	75037000	0	2.828	8	9	9	1
10	75270000	0.543	6.913	16	17	16	3
11	36001000	8.419	8.419	1	1	1	0
12	11050101	0.655	0.655	1	1	1	0
13	73210000	1.218	1.218	1	1	0	1
14	70180000	2.58	2.58	1	1	1	0
15	75220000	0.541	1.459	2	2	0	2

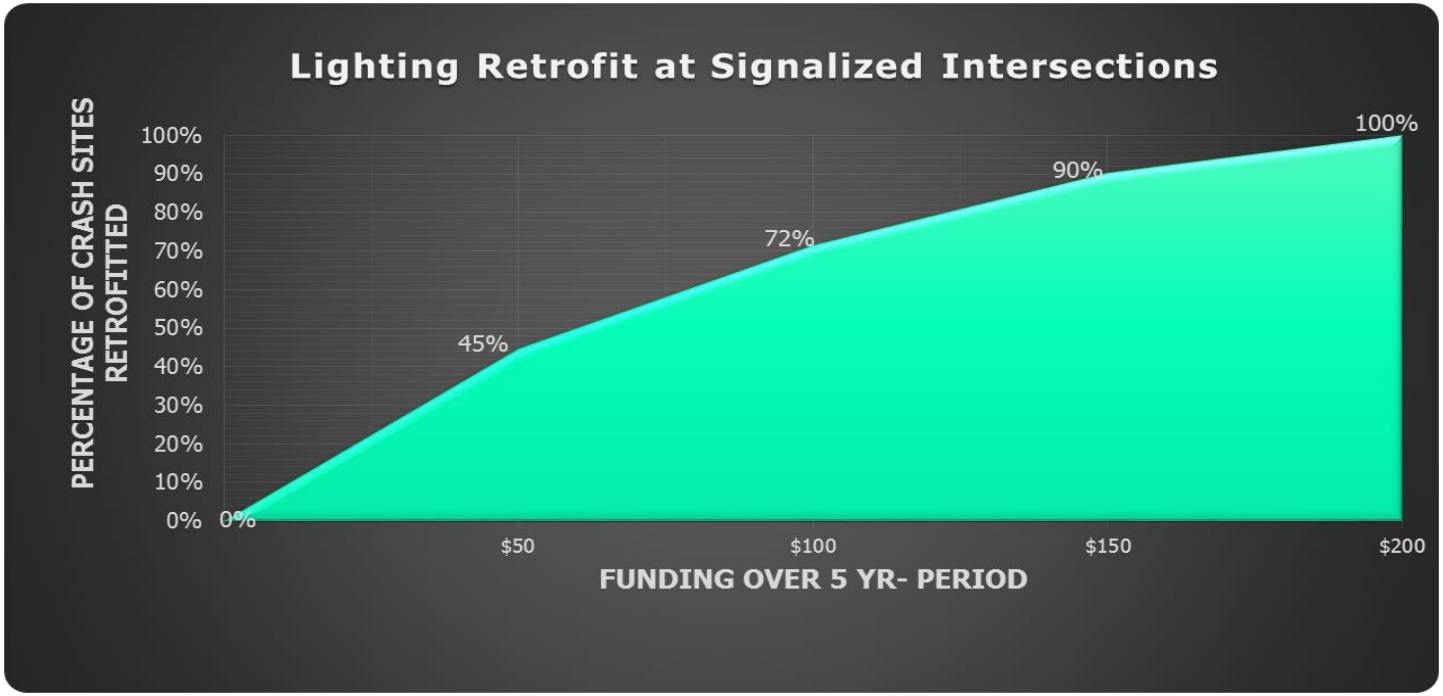
Safety Analysis of Nighttime Intersection Crashes

- Prioritized by Benefit Cost Ratios

	A	B	C	D	E	F	G	H	I	J	K
1	District -Rdwy ID	Begin MP	End MP	No. of Signals	No. of Crashes	No. of Injuries	No. of Fatalities	Retrofit Const. Cost	Sum of Annualized Cost	Sum of Annualized Benefit	Sum of B/C Ratio
2	District 5			982	557	529	86	$38,557,248	$2,837,813	$72,798,759	25.65
3	75251000	0.597	0.597	1	2	1	1	$39,264	$2,890	$261,396	90.45
4	79220002	0.067	0.367	5	9	9	0	$196,320	$14,449	$1,176,282	81.41
5	75250000	4.812	7.273	8	13	12	2	$314,112	$23,119	$1,699,073	73.49
6	70160000	4.773	5.01	2	3	2	1	$78,528	$5,780	$392,094	67.84
7	75010000	0.97	14.201	36	48	60	7	$1,413,504	$104,034	$6,273,502	60.30
8	75003000	0.652	10.606	26	34	35	9	$1,020,864	$75,136	$4,443,730	59.14
9	75037000	0	2.828	8	9	9	1	$314,112	$23,119	$1,176,282	50.88
10	75270000	0.543	6.313	16	17	16	3	$628,224	$46,237	$2,221,865	48.05
11	36001000	8.419	8.419	1	1	1	0	$39,264	$2,890	$130,698	45.23
12	11050101	0.655	0.655	1	1	1	0	$39,264	$2,890	$130,698	45.23
13	79210000	1.218	1.218	1	1	0	1	$39,264	$2,890	$130,698	45.23
14	70180000	2.58	2.58	1	1	1	0	$39,264	$2,890	$130,698	45.23
15	75220000	0.541	1.459	2	2	0	2	$78,528	$5,780	$261,396	45.23

Safety Analysis of Nighttime Intersection Crashes

- Proposed Work Program Amendment



PPM Criteria for New or Reconstructed Signalized Intersections

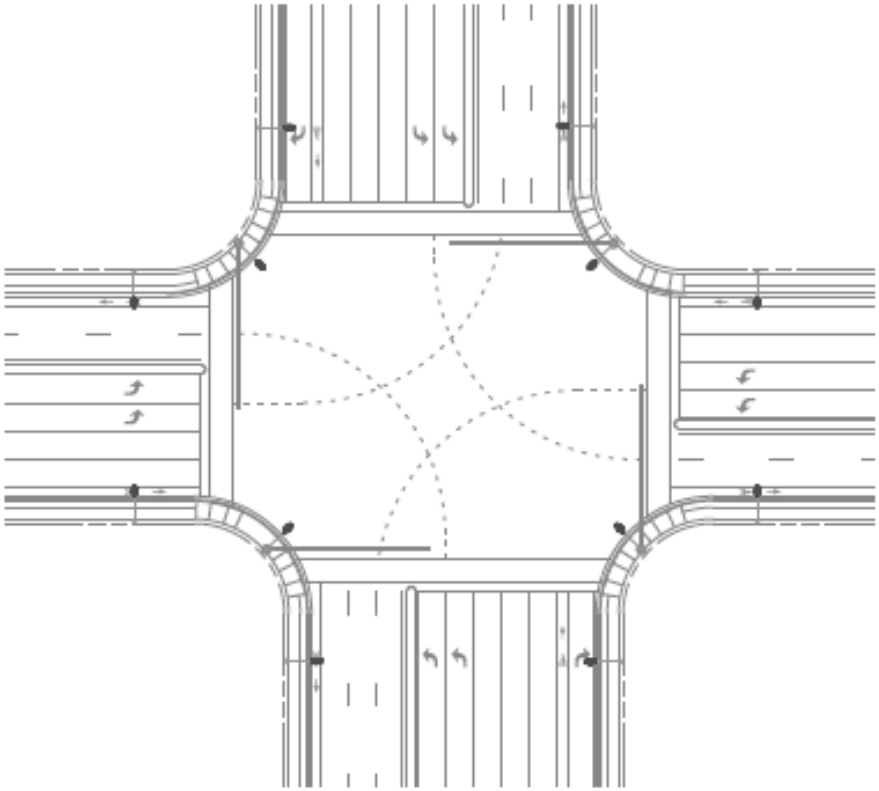
Table 7.3.3 Signalized Intersection Lighting
Urban 3 to Urban 5 Designated Areas

ROADWAY CLASSIFICATIONS	ILLUMINATION LEVEL AVERAGE INITIAL FOOT CANDLE		ILLUMINATION UNIFORMITY RATIOS		VEILING LUMINANCE RATIO
			AVG./MIN.	MAX./MIN.	Lv(max)/Lavg
MAJOR ARTERIALS	Horizontal (H.F.C.)	3.0	4:1 or Less	10:1 or Less	0.3:1 or Less
	Vertical (V.F.C.)	2.3*	N.A.	N.A.	N.A.

Note: * Vertical illumination value is only valid for new projects or where the intersection is being reconstructed. The vertical illumination is a target value and may not be achievable for all traffic movements.

PPM Criteria for New or Reconstructed Signalized Intersections

Figure 7.3.4 Typical Lighting Layout for Large Intersection



Performance Criteria for Retrofitted Intersections

Table 1: Signalized Intersection Lighting Retrofits

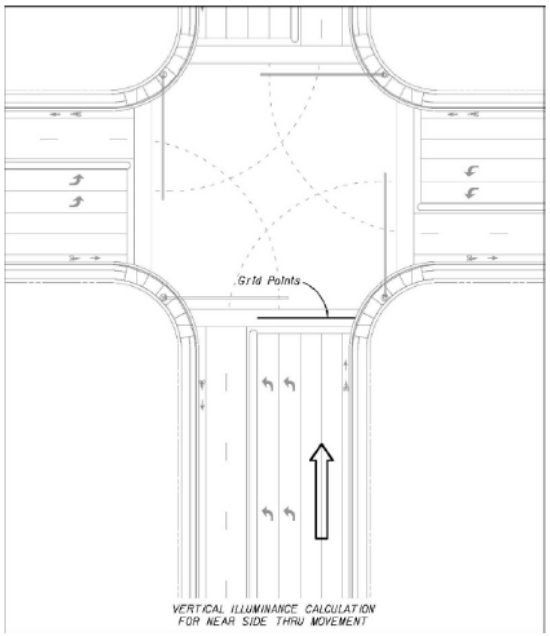
ROADWAY CLASSIFICATIONS	ILLUMINATION LEVEL AVERAGE INITIAL HORIZONTAL FOOT CANDLE (H.F.C.)	ILLUMINATION UNIFORMITY RATIOS		VEILING LUMINANCE RATIO Lv_{max}/L_{avg}
		AVG./MIN.	MAX./MIN.	
INTERSTATE, EXPRESSWAY, FREEWAY & MAJOR ARTERIALS	1.5	4:1 or Less	10:1 or Less	0.3:1 or Less
ALL OTHER ROADWAYS	1.0	4:1 or Less	10:1 or Less	0.3:1 or Less

Performance Criteria for Retrofitted Intersections

Vertical Illumination

The lighting design shall meet an average vertical illumination value of 1.5 fc for the all the near side approaches to the intersection.

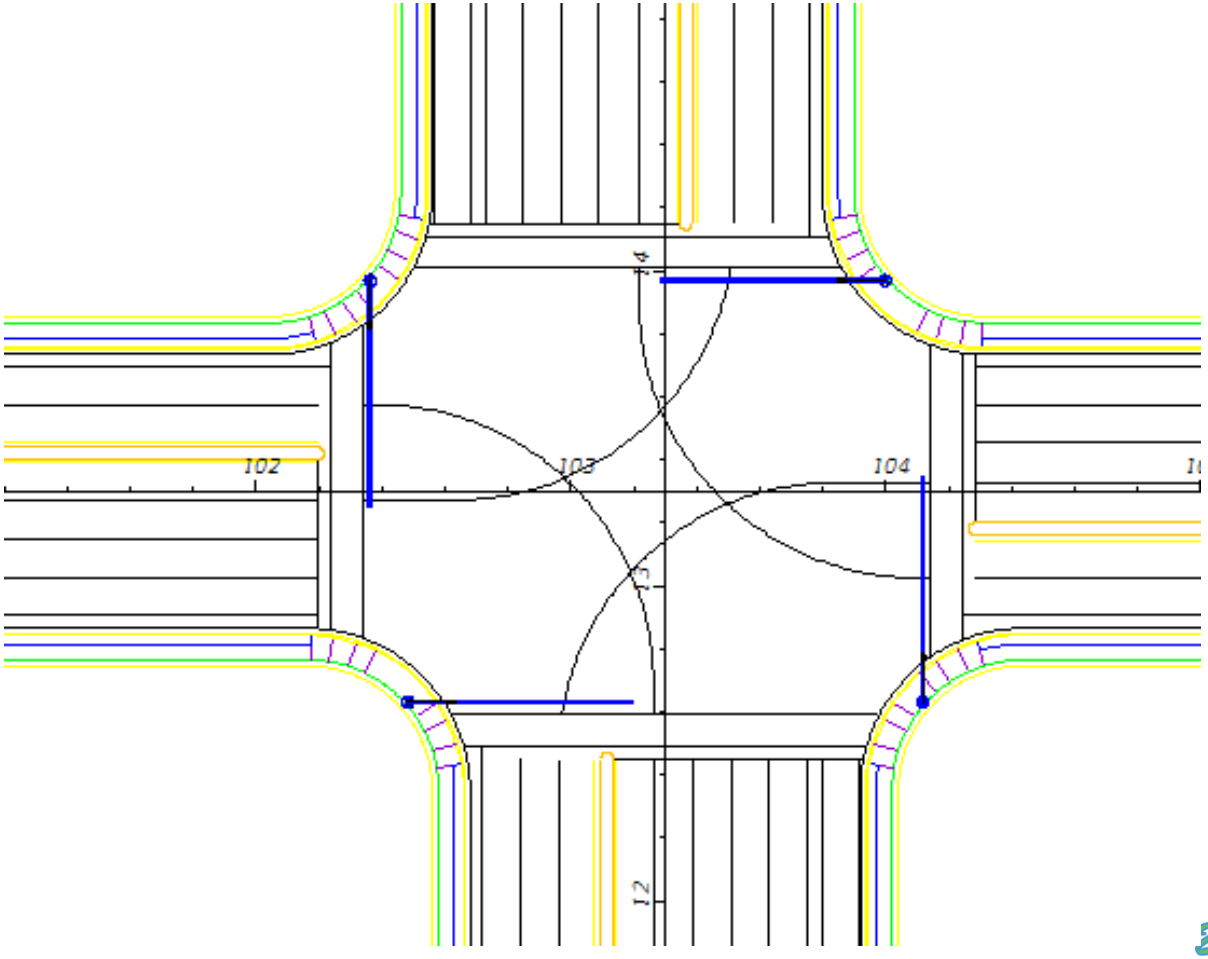
Figure 7.3.1 Vertical Illuminance Calculation for Near Side Movement



Performance Criteria for Retrofitted Intersections

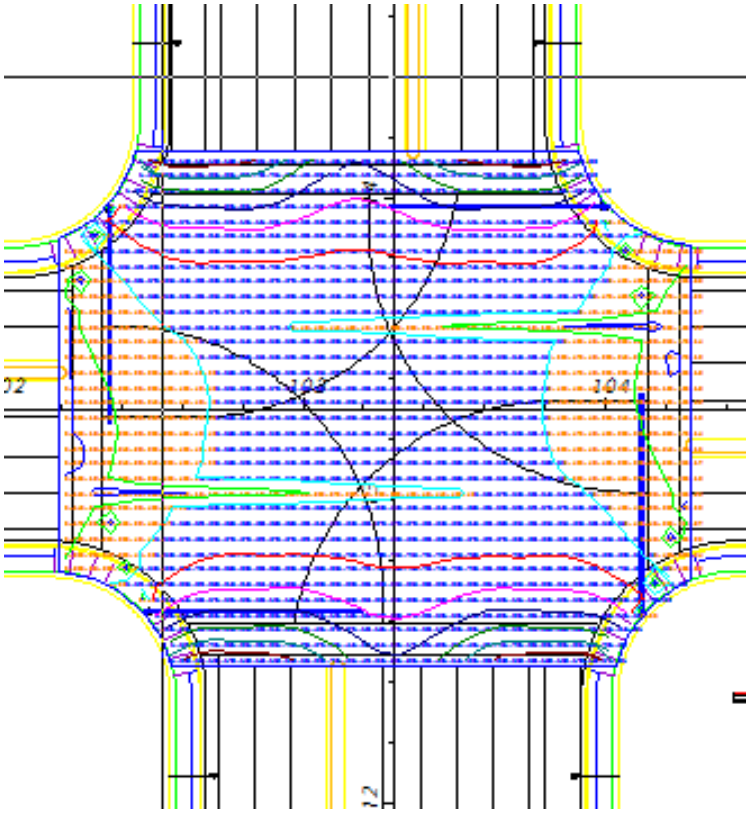
All existing and proposed fixtures at the intersection shall be converted to LED fixtures.

Validation of Retrofit Values



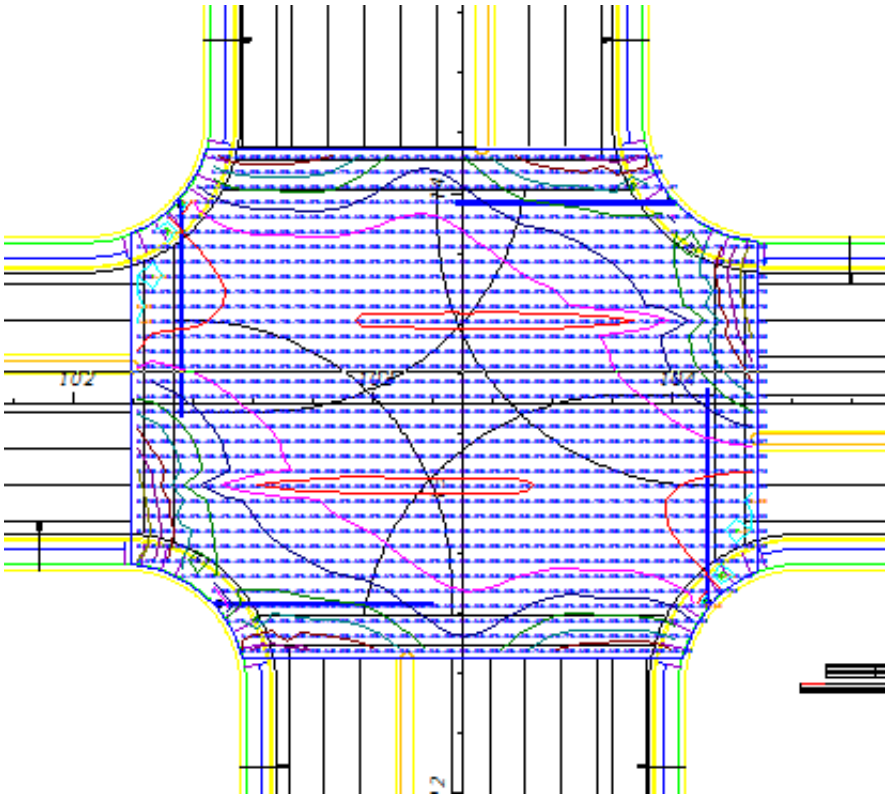
Validation of Retrofit Horizontal Lighting Values

Intersection w/Existing Lighting on Main Roadway and No Side Street Lighting



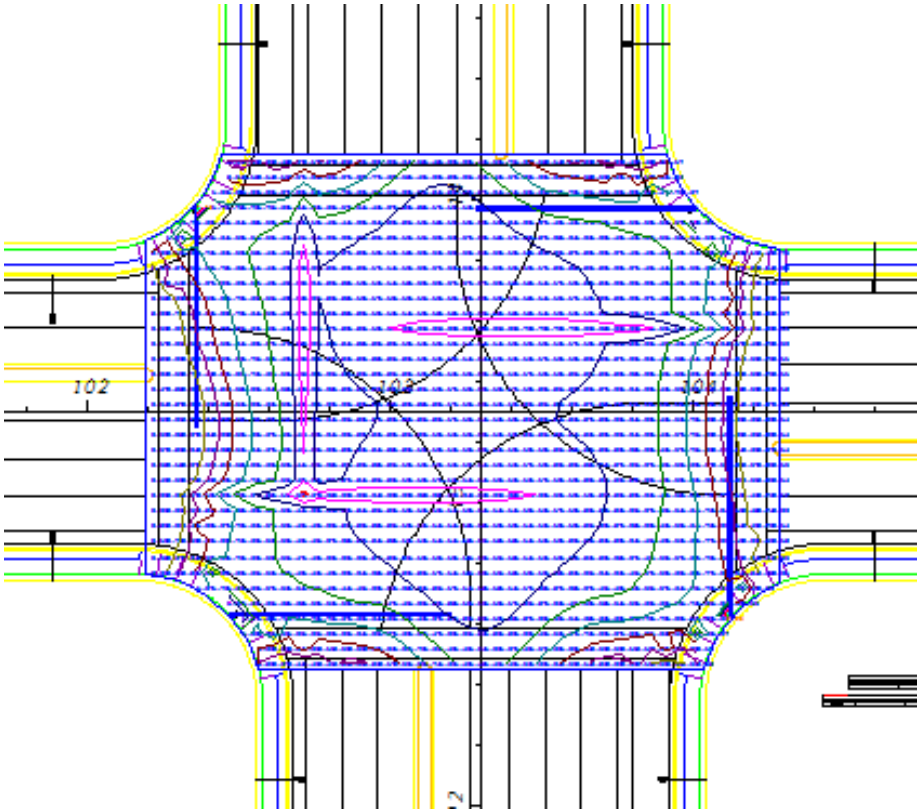
Validation of Retrofit Horizontal Lighting Values

Intersection w/Adjusted HPS Lighting on Main Roadway and Side Street Lighting on One Side



Validation of Retrofit Horizontal Lighting Values

Intersection w/Adjusted HPS Lighting on Main Roadway and Side Street Lighting on Both Sides

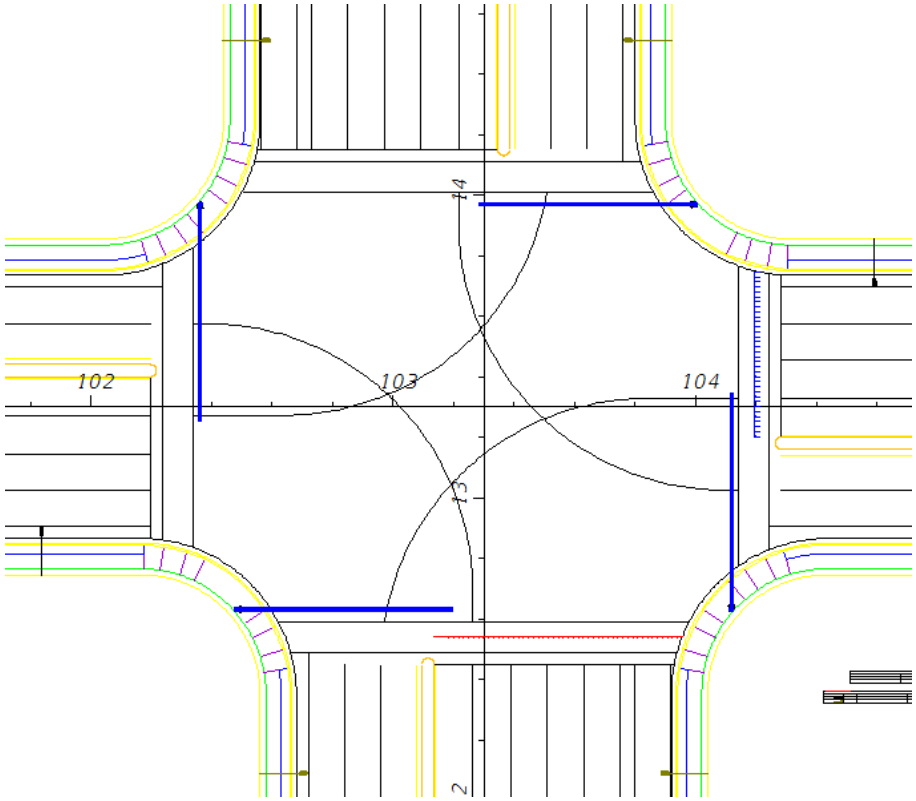


Validation of Retrofit Horizontal Lighting Values

		Horizontal Illumination				
Manufacturer	**LED Type**	**Avg**	**Max**	**Min**	**Avg/Min**	**Max/Min**
	HPS (Single)	1.16	2.82	0.38	3.1	7.4
	HPS (Double)	1.60	3.59	0.79	2.0	4.5
General Electric	ERS (Single)	0.93	2.35	0.07	13.3	33.6
General Electric	ERS (Double)	1.28	3.87	0.47	2.7	8.2
Phillips	RFL (Single)	1.26	2.68	0.11	11.5	24.4
Phillips	RFL (Double)	1.60	3.59	0.79	2.0	4.5
Schreder	SML (Single)	1.11	2.89	0.13	8.5	22.2
Schreder	SML (Double)	1.52	3.21	0.80	1.9	4.0

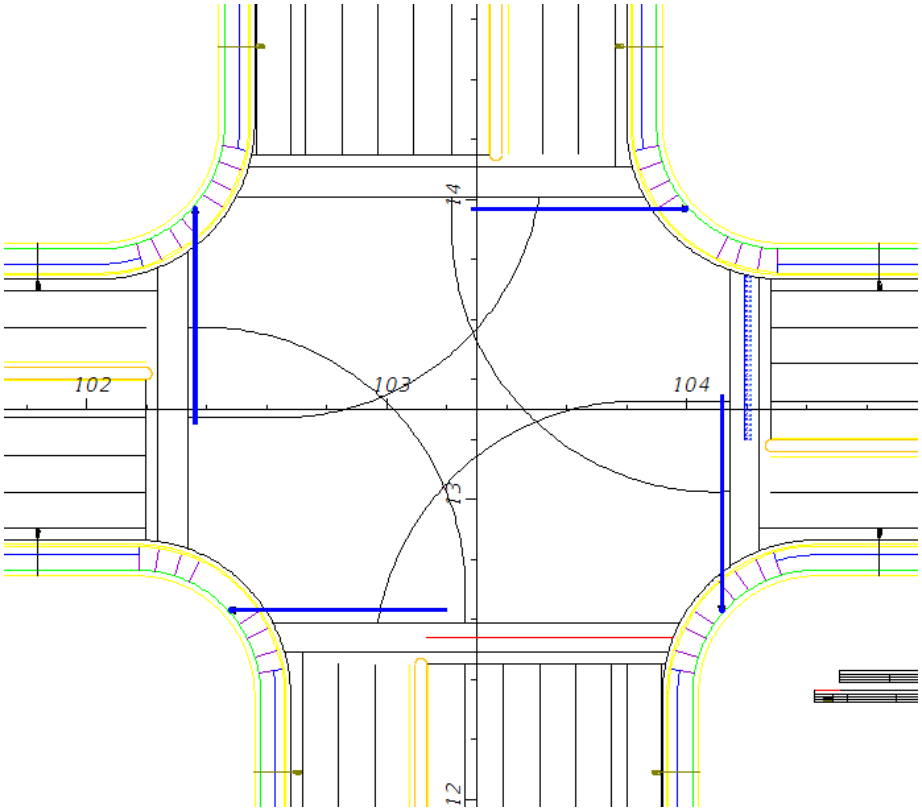
Validation of Retrofit Vertical Lighting Values

Intersection w/Adjusted HPS Lighting on Main Roadway and Side Street Lighting on One Side



Validation of Retrofit Vertical Lighting Values

Intersection w/Adjusted HPS Lighting on Main Roadway and Side Street Lighting on Both Sides



Validation of Retrofit Vertical Lighting Values

Vertical Calculations								
		Vertical Illumination (Fc) - Near Side Crosswalk						
		Main Road				Cross Street		
Manufacturer	LED Type	Rt. Turn Lanes	Through Lanes	Lt. Turn Lanes	Avg. All Lanes	Through Lanes	Lt. Turn Lanes	Avg. All Lanes
General Electric	HPS (Single)	3.0	2.0	1.2	2.0	2.4	1.7	2.1
General Electric	HPS (Double)	3.0	2.1	1.2	2.0	2.6	2.6	2.6
General Electric	ERS (Single)	1.5	1.5	0.3	1.1	2.0	1.7	1.8
General Electric	ERS (Double)	1.5	1.5	0.3	1.1	2.0	2.1	2.0
Phillips	RFL (Single)	2.4	1.8	0,4	1.5	2.7	1.4	2.1
Phillips	RFL (Double)	2.4	1.8	0.4	1.5	2.7	2.2	2.5
Schreder	SML (Single)	2.0	1.8	0.6	1.5	2.4	1.7	2.1
Schreder	SML (Double)	2.0	1.8	0.6	1.5	2.5	2.7	2.6

Challenges

Questions

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